REMARKS

Claims 1-19 are all the claims pending in the application. Claims 1, 4 and 6 have been amended and new claims 17-19 have been added. Claims 1 and 4 have been amended to delete parenthesis in the claims. Claim 6 has been amended to incorporate claims 3 and 5 and new claim 17 corresponds to claim 6 and incorporates claims 4 and 5. Support for new claims 18 and 19 can be found, for example, on page 6, lines 7-22 of the present specification.

The specification and claims 4 and 6 have been amended to replace "titanate" with --titanium salt--. In the present application, both "titanium salt" and "titanate" in were translated as "titanate". A person of ordinary skill in the art would easily recognize that "titanate" actually should be "titanium salt" in various parts of the specification. For example, titanium tetrachloride and titanium sulfate are listed as "titanate". *See* page 12, lines 5-6 of the present specification. However, titanium tetrachloride and titanium sulfate are not titanate but titanium salts. In addition, page 12, lines 6-7 disclose that "titanate" is subjected to hydrolysis in an acid solution; however, in the Examples, titanium salt, which are titanium tetrachloride or titanium sulfate, is subjected to hydrolysis in an acid solution. Therefore, the substance subjected to hydrolysis in an acid solution is "titanate salt", which has been mistranslated as "titanate". Accordingly, Applicants submit that a person of skill in the art would recognize the error and would recognize the appropriate correction.

Entry of the above amendments is respectfully requested.

Initially, Applicants thank the Examiner for acknowledging Applicants' claim to

domestic priority under 35 U.S.C. §119.

I. Abstract

In response to the Examiner objection to the abstract because it is too long and contains two paragraphs, Applicants have replaced the abstract with an abstract that contains one paragraph and is 150 words or less.

Accordingly, Applicants respectfully request that the objection be withdrawn.

II. Response to rejection of claims 1, 6 and 14 under 35 U.S.C. § 112, second paragraph

On pages 2-3 of the Office Action, the Examiner rejects claims 1, 6 and 14 under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

With respect to claim 1, the Examiner will note that Applicants have deleted the parenthesis around the wherein clause, as suggested by the Examiner.

In addition, with respect to claim 6, Applicants have amended claim 6 to incorporate claims 3 and 5, and have added new claim 17, which corresponds to claim 6 and incorporates claims 4 and 5.

In view of the above, Applicants respectfully request that the rejections be withdrawn.

III. Response to rejection of claims 1, 6 and 14 under 35 U.S.C. § 102/103

On pages 3-4 of the Office Action, the Examiner rejects claims 1, 6 and 14 under

35 U.S.C. § 102(b) as allegedly anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Japan 7-277710, JP 7-291607, Matsushita (U.S. Patent 4,898,843), Bernier (U.S. Patent 4,937,213) or Watanabe (U.S. Patent 5,204,031A)

The Examiner directs Applicants' attention to the search report corresponding to WO 00/35811, the abstract of Matsushita, col. 5 of Bernier, and col. 3 of Watanabe.

Applicants respectfully traverse this rejection for the following reasons.

1. JP 7-277710 and JP 7-291607

Applicants respectfully submit that JP 7-277710 and JP 7-291607 does not teach or suggest the particle of the present invention according to claim 1.

JP 7-277710 discloses perovskite compound particles, which have average primary particle size of 0.01-1 μm, an average secondary particle size of 0.01-1μm and BET specific surface area of 1-20 m^2/g. *See* paragraph [0006] and [0008] of the partial translation of JP 7-277710 submitted herewith.

The average particle sizes of JP 7-277710 are measured by laser diffraction scattering method. *See* Example 1. However, the D_1 value of the present invention is calculated from BET specific surface area (formula (II)), and the primary particle size of JP 7-277710 does not correspond to the D_1 value of the present invention.

BET specific surface area described in the present invention is 10-200 m^2/g, which is 10 times larger than JP 7-277710's BET specific surface area. JP 7-277710 only discloses particles having BET specific surface area of 10 m^2/g or more in Example 3 as $Ba(Ti_{0.90}Sr_{0.10})O_3$, which is not a $M(TiO_3)$ compound. All of the $M(TiO_3)$ compounds

disclosed by JP 7-277710 have a BET surface area of less than 10 m^2/g.

Therefore, JP 7-277710 does not teach or suggest the particle of the present invention according to claim 1.

JP 7-291607 discloses perovskite compound particles that have a particle size converted from a specific surface area (SS) of 3 nm, and a crystal particle size, calculated from the diffraction width of XRD, of 4 nm. *See* paragraph [0038] of the partial translation of JP 7-291607 submitted herewith. JP 7-291607 also discloses that primary particles of several nm are aggregated to form a secondary particle of 0.1 to 0.3 μm, which can be seen by observation through an electron microscope. *See* paragraph [0038]. In addition, D_2 (0.1 - 0.3 μm)/D_1 (3-4 nm) ratio of the perovskite compound of JP 7-291607 is about 25-100, which is not within the range of 1 to 10 of the present invention.

100 – 300 nm

0.1 μm = 100 nm

Therefore, JP 7-291607 does not teach or suggest the particle of the present invention according to claim 1.

2. Matsushita, Bernier, and Watanabe

Matsushita appears to disclose barium titanate powder with a specific surface area which is 20 m^2/g or less and a particle size of 0.07 to 0.5 μm. Bernier discloses $SrTiO_3$ particles with a specific surface area of 10-20 m^2/g and a particle size of 0.1-0.5 μm. Watanabe discloses a $PbTiO_3$ particles with a specific surface area of 20-70 m^2/g and converted particle diameter of 0.05 μm or less.

However, the prior art references do not disclose secondary particle sizes (i.e.,

agglomerated particles of primary particles) particles or a ratio of D_2/D_1 that is 1 to 10. Accordingly, the cited prior art references fail to teach or suggest the present invention according to claim 1.

In addition, with respect to the present invention according to claim 6, none of the cited prior art references discloses the use of a titanium oxide particle comprising brookite or subjecting titanium salt to hydrolysis in an acid solution to obtain perovskite oxide particles. Therefore, the cited prior art references do not disclose a process for obtaining the particles of the present invention according to claim 1.

In particular, the perovskite oxide particles produced by the present invention are made from titanium oxide particles where anionic ions such as chlorine ions and sulfate ions are not readily trapped in the inside of the particle. *See* page 12, line 5 to page 13, line 8 of the present specification. It is difficult to remove the anionic ions from the inside of the particle, and the cited prior art references do not disclose that the particles produced by their processes have are reduced in such impurity anionic ions.

Therefore, the processes of the cited prior art produce particles that are different from the particles of the present invention. Accordingly, the process limitations define the present invention and are novel and not obvious.

In view of the above, Applicants respectfully request that the rejection be withdrawn.

IV. <u>Response to rejection of claims 1 and 6 under 35 U.S.C. § 102(b)</u>

In addition, the Examiner rejects claims 1 and 6 under 35 U.S.C. § 102(b) as allegedly anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Lilley (U.S. Patent 4,764,493).

The Examiner directs Applicants' attention to col. 5 of Lilley.

In response, Applicants respectfully traverse for the following reasons.

Lilley discloses barium titanate powders; however, Lilley does not disclose a specific particle size of secondary particles, which is important to evaluate the particle with a ratio of D_2/D_1. For example, the particles of the present invention, which have a D_2/D_1 ratio, exhibit sufficient transparency when formed into the film, and are suitable for use as a photocatalyst. *See* page 7, lines 12-20 and Example 5 of the present specification. Lilly does not disclosed particles that have such functions.

Therefore, Lilley fails to teach or suggest the present invention according to claim 1.

With respect to the present invention according to claim 6, Lilley does not disclose the use of a titanium oxide particle comprising brookite or subjecting titanate to hydrolysis to obtain the particles of the present invention. Therefore, the particles of the present invention are different from the particles of Lilley, for the same reasons discussed above. Accordingly, the process limitations define the present invention and are novel and not obvious.

In view of the above, Applicants respectfully request that the rejection be

withdrawn.

V. Response to rejection of claims 1 and 6 under 35 U.S.C. § 103

On pages 4-5 of the Office Action, the Examiner rejects claims 1 and 6 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kiss in view of Bruno.

The Examiner cites Kiss as teaching a barium titanate having a particle size of less than 800 angstroms (80 nm), but having a different surface area. The Examiner cites Bruno as disclosing the process of Kiss and teaching a surface area of 12.5 m^2/g or higher.

Applicants respectfully traverse this rejection for the following reasons.

Kiss and Bruno do not disclose secondary particle sizes (i.e., agglomerated particles of primary particles), and therefore, do not disclose the particles of the present invention, which have a ratio D_2/D_1 that is 1 to 10. Therefore, Kiss and Bruno do not teach or suggest the present invention according to claim 1.

With respect to the present invention according to claim 6, Kiss and Bruno do not disclose using a titanium oxide particle comprising brookite to obtain titanate particles. Therefore, the particles of the present invention are different from the particles of Kiss and Bruno, and the process limitations define the present invention since the particles of the present invention cannot be obtained by the process of the prior art, for the reasons discussed above.

Accordingly, the present invention is not obvious in view of Kiss and Bruno, and Applicants respectfully request that the rejection be withdrawn.

VI. Response to rejection of claim 6 under 35 U.S.C. § 103

On pages 4-5 of the Office Action, the Examiner rejects claim 6 under 35 U.S.C. § 103(a) as allegedly being unpatentable over JP 6-305729, JP 11-228139 or JP 7-069635.

The Examiner directs Applicants' attention to the search report for WO 00/35811.

Initially, Applicants submit that JP 11-228139 was published on August 24, 1999, which is after the effective filing date of May 26, 1999 (filing date of provisional application) for the present application. Accordingly, Applicants respectfully submit that JP 11-228139 is not a proper reference, and request that it be removed.

Applicants submit that JP 6-305729 and JP 7-069635 disclose particles that contain SO_3, and therefore do not disclose particles of the present invention. In addition, 6-305729 and JP 7-069635 do not disclose using a titanium oxide particle comprising brookite to obtain titanate particles. Accordingly, the particles of the present invention are different from the particles of Kiss and Bruno, and the process limitations define the present invention since a particle different from the prior art can be obtained by the process of the present invention, for the reasons discussed above.

Accordingly, Applicants respectfully submit that 6-305729 and JP 7-069635 do not teach or suggest the present invention, and respectfully request that the rejection be withdrawn.

VII. Conclusion

In view of the above, reconsideration and allowance of this application are now

believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Applicant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee, except for the Issue Fee, for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 9, the paragraph bridging pages 9 to 11:

Of the above-mentioned production processes, the process is not particularly limited as long as titanium oxide particles comprising the brookite crystalline form can be obtained. However, the method of obtaining a titanium oxide sol by subjecting a [titanate] titanium salt to hydrolysis in an acid solution, which was previously invented by the inventors of the present invention, is preferable. This is because when the titanium oxide particles obtained by the above-mentioned method are made into a titanium-containing composite oxide, a perovskite titanium oxide particle with a small particle size and excellent dispersion properties can be obtained. More specifically, preferable methods include adding titanium tetrachloride to hot water at 75 to 100°C to carry out hydrolysis of the titanium tetrachloride at a temperature which is more than or equal to 75°C, and less than or equal to the boiling point of the solution, with the concentration of the chlorine ions being controlled, thereby obtaining titanium oxide particles with a brookite crystalline structure in the form of a titanium oxide sol (Japanese Patent Application 9-231172), and adding titanium tetrachloride to hot water at 75 to 100°C to carry out hydrolysis of the titanium tetrachloride in the presence of nitrate ions and/or sulfate ions at a temperature which is more than or equal to 75°C, and less than or equal to the boiling point of the solution, with the total concentration of chlorine ions, nitrate ions, and sulfate ions being controlled, thereby obtaining

titanium oxide particles with a brookite crystalline structure in the form of a titanium oxide sol (Japanese Patent Application 10-132195).

Page 11, the paragraph bridging pages 11 and 12:

To produce a sol in which the perovskite titanium-containing composite oxide particles of the present invention are dispersed, a titanium oxide sol obtained by subjecting a [titanate] titanium salt to hydrolysis in an acid solution may be used instead of the titanium oxide particles with a brookite crystalline form. There is no limitation to the crystalline form of titanium oxide particles in the titanium oxide sol as long as the titanium oxide sol is obtained by carrying out the hydrolysis of the [titanate] titanium salt in an acid solution.

Page 12, the paragraph bridging pages 12 and 13:

When the [titanate] titanium salt such as titanium tetrachloride or titanium sulfate is subjected to hydrolysis in an acid solution, the reaction rate is reduced as compared with the case where the hydrolysis is carried out in a neutral or alkaline solution. Therefore, the particles can be formed in separate single particles, thereby obtaining a titanium oxide sol with excellent dispersion properties. Further, since anionic ions such as chlorine ions and sulfate ions are not readily trapped in the inside of the generated titanium oxide particles, it is possible to restrain the inclusion of anionic ions in the particles in the course of production of the titanium-containing composite oxide particles. In addition, when a [titanate] titanium salt is subjected to hydrolysis in a neutral or alkaline solution, the reaction rate is increased to cause considerable nucleation in the initial stage. The result is that the obtained titanium oxide sol shows poor dispersion properties although the particle size is small, and

consequently the particles tend to form a cloud-like aggregate. When such a titanium oxide sol is made into a sol of titanium-containing composite oxide particles, the dispersion properties become poor although the particle size of the particles in the sol is small. In addition, the anionic ions are easily trapped in the inside of the titanium oxide particles in the sol. The removal of these anionic ions will thus become difficult in the subsequent processes.

Page 13, the first full paragraph:

The method of obtaining a titanium oxide sol by subjecting a [titanate] <u>titanium salt</u> to hydrolysis in an acid solution is not particularly limited as long as the solution can be maintained acid. The method of subjecting titanium tetrachloride serving as a raw material to hydrolysis in a reaction vessel equipped with a reflux condenser, the solution being maintained acid by inhibiting the chlorine atom generated in the course of hydrolysis from escaping, which method was previously invented by the inventors of the present invention (Japanese Patent Application 8-230776) is preferable.

Page 13, the paragraph bridging pages 13 and 14:

It is preferable that the acid solution of a [titanate] <u>titanium salt</u> serving as the raw material have a concentration of about 0.01 to about 5 mol/L. When the concentration exceeds about 5 mol/L, the reaction rate of the hydrolysis is accelerated, and a titanium oxide sol with a large particle size and poor dispersion properties is obtained. When the concentration is less than about 0.01 mol/L, the density of the titanium oxide particles in the obtained sol is decreased, which lowers the productivity.

Page 14, the paragraph bridging pages 14 and 15:

The method for producing a sol in which the perovskite titanium-containing composite oxide particles are dispersed according to the present invention comprises the step of allowing the titanium oxide particles with a brookite crystalline form, or the titanium oxide sol obtained by subjecting a [titanate] titanium salt to hydrolysis in an acid solution to react with a metal salt comprising at least one of Ca, Sr, Ba, Pb, or Mg in a liquid phase. Although the reaction conditions are not particularly limited, in general, it is preferable to carry out the reaction in an alkaline solution by employing an alkaline liquid phase. It is preferable that the pH of the solution be about 13.0 or more, and more preferably 14.0 or more. When the pH is set to 14.0 or more, the particle size of the titanium-containing composite oxide particles dispersed in the sol can be decreased.

IN THE CLAIMS:

The claims are amended as follows:

1. (amended) A perovskite titanium-containing composite oxide particle having a composition represented by general formula (I), wherein the specific surface area is about 10 to about 200 m^2/g, the specific surface area diameter D_1 of primary particles defined by formula (II) is about 10 to about 100 nm, and a D_2/D_1 ratio of the average particle size D_2 of secondary particles to D_1 is about 1 to about 10:

$$M(TiO_3) \text{ - - - (I)}$$

[(] wherein M is at least one of Ca, Sr, Ba, Pb, or Mg [)],

$$D_1 = 6 / \rho S \text{ - - - (II)}$$

[(] wherein ρ is the density of the particles, and S is the specific surface area of

the particles. [)]

4. (amended) A process for producing sol in which a perovskite titanium-containing composite oxide particle represented by general formula (I) is dispersed, comprising the step of allowing a titanium oxide sol prepared by subjecting a [titanate] <u>titanium salt</u> to hydrolysis in an acid solution to react with a metal salt comprising at least one of Ca, Sr, Ba, Pb, or Mg in a liquid phase:

$$M\,(TiO_3)\quad ---\,(I)$$

[(] wherein M is at least one of Ca, Sr, Ba, Pb, or Mg. [)]

6. (amended) A perovskite titanium-containing composite oxide particle obtained by removing a dispersion medium from [said] <u>a</u> sol [as claimed in claim 5] <u>in which a perovskite titanium-containing composite oxide particle represented by general formula (I) is dispersed, wherein said sol is obtained by a process comprising the step of allowing a titanium oxide particle comprising brookite crystalline form to react with a metal salt comprising at least one of Ca, Sr, Ba, Pb, or Mg in a liquid phase:</u>

$$\underline{M\,(TiO_3)\quad ---\,(I)}$$

<u>wherein M is at least one of Ca, Sr, Ba, Pb, or Mg</u>.

New claims 17-19 have been added.

<u>**IN THE ABSTRACT:**</u>

The abstract has been changed as follows.

A perovskite titanium-containing composite oxide particle having a composition represented by general formula (I), [wherein] <u>where</u> the specific surface area is about

10 to about 200 m^2/g, the specific surface area diameter D_1 of primary particles defined by formula (II) is about 10 to about 100 nm, and a D_2/D_1 ratio of the average particle size D_2 of secondary particles to D_1 is about 1 to about 10:

$$M(TiO_3) \quad \text{- - - (I)}$$

[(] wherein M is at least one of Ca, Sr, Ba, Pb, or Mg [)],

$$D_1 = 6 / \rho S \text{ - - - (II)}$$

[(] wherein ρ is the density of the particles, and S is the specific surface area of the particles <u>is disclosed</u>. [)] <u>The present invention has a small particle size and excellent dispersion properties, so that the particle is suitable for application to functional materials.</u>

[The perovskite titanium containing composite oxide particle of the present invention shows a small particle size and excellent dispersion properties, so that the particle is suitable for the application to functional materials such as a dielectric material and a piezoelectric material, a memory, and a photocatalyst.]